

# A-Train 2010 Abstract Submissions

*Category: carbon cycle*

		Accepted Abstract Format	Abstract
Name	Abstract Title		
1. François-Marie Breon LSCE / IPSL / ICARE	Vegetation dynamic monitoring from space: The need for (and how to apply) directional correction	Talk	<p>Visible and near-IR imagery is a powerful source of information to follow the vegetation dynamic from space, i.e. its annual cycle and the inter-annual anomalies that result from meteorological forcing. A quantitative use of the solar reflectance time-series requires a correction for the viewing/solar geometry. Indeed, for a given target, the measurement can vary by a factor larger than two depending on the observation geometry, which is often larger than the signal that is sought.</p> <p>The Parasol satellite which is part of the A-Train provides the necessary information to measure the Bidirectional Reflectance Distribution Function (BRDF) for natural targets. We have processed its measurements to analyze the typical shape and variability of natural targets BRDFs. It confirmed that most BRDFs can be easily modeled by a linear three parameter function.</p> <p>We then have developed a method for the correction of MODIS reflectance time series: The correction assumes a slow variation of the surface reflectance and inverts the BRDF parameters. The corrected time series are much smoother than their original counterparts, and retain the original temporal resolution. This corrected dataset enables an enhanced monitoring of the vegetation dynamic with high precision and temporal resolution. We will show two applications that make use of this novel dataset of reflectance time series:</p> <ul style="list-style-type: none"><li>- An accurate monitoring of crop state during the growing season that can be used for a pre-harvest estimate of the yield, in excellent agreement with the actual values.</li><li>- The retrieval of vegetation phenology at fine temporal scale (daily), that can be used to validate/constrain vegetation dynamic models and understand some of the basic climate forcings.</li></ul>

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2.	Dr. Eui-Seok Chung <i>Univ. of Miami</i>		Satellite-inferred tropospheric carbon dioxide distribution and its comparison with data assimilation products	Poster	<p>Spatial distributions of carbon dioxide concentration in the mid-troposphere are inferred from decadal trends observed in the High-Resolution Infrared Radiation Sounder (HIRS) carbon dioxide channels in conjunction with the mid-tropospheric carbon dioxide concentration retrieved from Atmospheric Infrared Sounder (AIRS) measurements. The HIRS observations show a qualitatively homogeneous decadal trend over the entire globe in association with the increased anthropogenic carbon emission. However, the extra-tropical regions exhibit more significant decadal trends compared to the tropics, consistent with the geographical distribution of the AIRS-retrieved mid-tropospheric carbon dioxide. Furthermore, inter-channel differences of HIRS carbon dioxide channels reveal a noticeable meridional variation, implying an inhomogeneous vertical distribution of carbon dioxide in the troposphere. Comparison of the AIRS mid-tropospheric carbon dioxide concentrations with in-situ measurements denotes a similar latitudinal variation of carbon dioxide vertical distribution. Sensitivity tests through radiative transfer simulations confirm these results in qualitative sense.</p> <p>We also compare the satellite-inferred spatial distributions of carbon dioxide with those produced from a data assimilation system (NOAA CarbonTracker). Generally consistent spatial patterns are identified in the tropics and the northern hemisphere. By contrast, the extra-tropical regions of the southern hemisphere show substantial discrepancies in concentration and vertical distribution. These results suggest that satellite measurements can be utilized for improving our understanding of processes controlling the atmospheric carbon dioxide distribution and global carbon cycle in cooperation with data assimilation systems.</p>

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3.	Dr. David Crisp <i>Jet Propulsion Laboratory, California Institute of Technology</i> Opportunities for Synergistic Measurements between the Orbiting Carbon Observatory-2 (OCO-2) and other A-Train Missions	Talk	<p>The Orbiting Carbon Observatory-2 (OCO-2) mission is currently scheduled to join the Earth Observing System Afternoon Constellation (EOS A-Train) in early 2013. The primary objective of the OCO-2 Mission is to return measurements of the column averaged atmospheric carbon dioxide (CO<sub>2</sub>) dry air mole fraction, XCO<sub>2</sub>, with the sensitivity, accuracy, coverage, and sampling density needed to quantify regional scale carbon sources and sinks and characterize their variability over the seasonal cycle. To do this, the OCO-2 instrument will collect over 500,000 soundings along a narrow swath, either along the spacecraft ground track, or along the apparent path traversed by the sun glint spot, as the spacecraft moves from south to north along the sunlit side of its orbit. Each sounding consists of co-boresited, high resolution, spectroscopic measurements of reflected sunlight within the two CO<sub>2</sub> bands centered near 1610 and 2060 nm, and within the molecular oxygen (O<sub>2</sub>) A-band, centered near 764 nm. The measurements from each sounding will be analyzed with a remote sensing retrieval algorithm to estimate the column abundances of CO<sub>2</sub>, O<sub>2</sub>. To meet its stringent accuracy requirements for XCO<sub>2</sub>, this algorithm will simultaneously retrieve estimates of the vertical profiles of cloud and aerosol optical depth, water vapor and air temperature, as well as the surface pressure and the surface reflectance from each sounding.</p> <p>Flying OCO-2 at the front of the A-Train, just ahead of the GCOM-W1 satellite, will facilitate efforts to combine OCO-2 measurements with data from other A-Train satellites and provide opportunities for joint calibration and validation activities, complementing the OCO-2 science return. OCO-2 estimates of XCO<sub>2</sub> can be combined with AIRS and TES observations of CO<sub>2</sub> in the middle and upper troposphere to yield constraints on the CO<sub>2</sub> profiles. OCO-2 XCO<sub>2</sub> estimates could also be combined with coincident MODIS measurements of land cover type, leaf area index, net primary productivity, fire occurrence, and ocean color to help quantify the CO<sub>2</sub> fluxes associated with these processes. In addition, the OCO-2 O<sub>2</sub> A-band spectrometer will collect &gt;100,000 surface pressure and ~400,000 cloud top pressure measurements each day, with accuracies near 1 hPa on synoptic scales. The surface pressure measurements can be combined with AIRS temperature and moisture measurements in meteorological data assimilation models to assess their impact on weather forecasts. The OCO-2 cloud top pressure estimates could be combined with CloudSat and CALIPSO measurements to more completely constrain the occurrence of thin, high clouds and their impact on the solar radiation budget. Meanwhile, cloud and aerosol measurements from MODIS, CloudSat, CALIPSO, and GLORY could be used to initialize and help validate the cloud and aerosol retrievals by OCO-2. Similarly, the AIRS temperature and humidity measurements could be used to validate OCO water vapor and temperature retrievals. This presentation will review these and other opportunities for synergistic measurements between OCO-2 and other A-Train missions.</p>

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4. Annmarie Eldering JPL/Caltech	THE ORBITING CARBON OBSERVATORY (OCO-2) MISSION	Talk	<p>The NASA Orbiting Carbon Observatory (OCO-2) will make space-based measurements of atmospheric CO<sub>2</sub> with the precision, resolution, and coverage needed to characterize CO<sub>2</sub> sources and sinks on regional scales and quantify their variability over the seasonal cycle. After the failed launch of OCO, Congress instructed NASA to restart the OCO mission in the 2010 budget authorization. The OCO-2 mission will undergo review for authorization to proceed in early October 2010, and could be ready for launch into the Earth Observing System Afternoon Constellation (A-Train) in February 2013. The OCO-2 mission will be a 'carbon copy' of the OCO mission, to minimize schedule and cost risks.</p> <p>OCO-2 will carry a single instrument that incorporates 3 high resolution grating spectrometers that will make bore-sighted measurements of reflected sunlight in near-infrared CO<sub>2</sub> and molecular oxygen (O<sub>2</sub>) absorption bands. These measurements will be combined to provide spatially resolved estimates of the column-averaged CO<sub>2</sub> dry air mole fraction, XCO<sub>2</sub>. The instrument collects 12 to 24 XCO<sub>2</sub> soundings/second over the sunlit portion of the orbit, yielding 200 to 400 soundings per degree of latitude, or 7 to 14 million soundings every 16 days. Thick clouds and aerosols will reduce the number of soundings available for XCO<sub>2</sub> retrievals by 80-90%, but the remaining data is expected to yield XCO<sub>2</sub> estimates with accuracies of ~0.3 to 0.5% (1 to 2 ppm) on regional scales every month. To verify the accuracy of the space-based XCO<sub>2</sub> data, the OCO-2 validation program will use ground-based, solar-viewing Fourier Transform Spectrometers (FTS) in the Total Carbon Column Observing Network (TCCON) to tie the space-based XCO<sub>2</sub> with the World Meteorological Organization (WMO) standard for atmospheric CO<sub>2</sub>, which is based on in situ observations of CO<sub>2</sub> from flask measurements, tall towers, and aircraft.</p> <p>This presentation will provide an overview of the OCO-2 mission, including science objectives, instrument, algorithm, and validation plans.</p>

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5.	Dr. David J Erickson <i>Oak Ridge National Lab</i>	Atmospheric CO2 simulation inside GEOS-5: Data assimilation, data fusion and treaty verification	Poster	<p>We present a multi-year simulation of atmospheric CO2 inside the NASA GEOS-5 modeling and assimilation system. These calculations represent an example of a simulated global climate model rendition of the NASA data streams that will flow into the geophysical/climate community science and assessment community over the next 5-10 years. The 3-D atmospheric wave structures and transport physics interact with spatially and time varying surface sources and sinks of CO2. This results in an exceedingly complicated evolution of atmospheric CO2 in time and space. Approaches such as this are applicable for initiating the assimilation of remotely sensed atmospheric CO2 concentrations such as those that will be available from future satellite missions. Data fusion and mining techniques may be applied to these 4-D model/satellite generated data sets for hundreds of geophysical climate variables. These finding have implications for inverse models that attempt to estimate surface source/sink regions especially when the surface sinks are co-located with regions of strong anthropogenic CO2 emissions. Intensive data mining, data fusion and knowledge discovery will contribute to the accurate determination of the sources and sinks of atmospheric CO2 , thus allowing quantitative input for treaty verification.</p> <p>However, current approaches are not well suited to fully exploit the multi-source, multi-resolution, and multi-modal datasets (m3) resulting from simulations and observations. Some of our recent research is focused on designing a unified data fusion and data mining framework tailored for m3 datasets. We are extending mixture models that admit m3 datasets. This unified framework allows integration of climate model outputs with remote sensing and ground observations. Data mining solutions can then be leveraged on m3 framework with suitable extension to analyze petascale datasets to extract useful patterns, correlations, and anomalies.</p>

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6. Yongxiang Hu NASA Langley Research Center	Using CALIPSO lidar backscatter measurements for improving estimation of air-sea CO <sub>2</sub> fluxes	Talk	<p>With its dual-wavelength (532 nm and 1064 nm), dual polarization lidar, the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission has been making global measurements of vertical backscatter profiles of the atmosphere and ocean since June 2006. Thanks to the support from NASA biogeochemistry program in the last three years, we have demonstrated that both daytime and nighttime CALIPSO lidar measurements can be used for estimating the following ocean surface and subsurface physical properties:</p> <ul style="list-style-type: none"><li>• the mean square slopes (MSS) of ocean surface waves;</li><li>• the presence and concentration of bubbles; and</li><li>• the sub-surface particulate backscatter at 532 nm.</li></ul> <p>The mean square wave slopes and bubble concentrations derived from CALIPSO may help reduce uncertainties in estimating air-sea gas transfer velocities. The sub-surface particulate backscatter profiles estimated from CALIPSO may help improve estimates of primary productivity and particulate inorganic carbon (PIC). As these CALIPSO ocean measurements are self-calibrated, the spatial and temporal statistics of these CALIPSO ocean surface and sub-surface measurements are potentially useful for improving the understanding of various carbon cycle issues, such as ocean acidification. This study introduces the measurement concept and presents our preliminary results.</p>

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7. Matthew S Johnson North Carolina State University	Understanding the Transport of Patagonian Dust and its Influence on Marine Biological Activity in the South Atlantic Ocean	Talk	<p>The supply of bioavailable iron to the high-nitrate low-chlorophyll (HNLC) waters of the Southern Ocean through atmospheric pathways could stimulate phytoplankton blooms and have major implications for the global carbon cycle. In this study, model results and remotely-sensed data are analyzed to examine the horizontal and vertical transport pathways of Patagonian dust and quantify the effect of iron-laden mineral dust deposition on marine biological productivity in the surface waters of the South Atlantic Ocean (SAO). Model simulations for the atmospheric transport and deposition of mineral dust and bioavailable iron are carried out for two large dust outbreaks originated at the source regions of northern Patagonia during the austral summer of 2009. Model-simulated horizontal and vertical transport pathways of Patagonian dust plumes are in reasonable agreement with remotely-sensed data obtained from the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO). Simulations indicate that the synoptic meteorological patterns of high and low pressure systems are largely accountable for dust transport trajectories over the SAO. According to model results and retrievals from CALIPSO, synoptic flows caused by opposing pressure systems (a high pressure system located to the east or north-east of a low pressure system) elevate the South American dust plumes well above the marine boundary layer. Under such conditions, the bulk concentration of mineral dust can quickly be transported around the low pressure system in a clockwise manner, follow the southeasterly advection pathway, and reach the HNLC waters of the SAO and Antarctica in ~3-4 days after emission from the source regions of northern Patagonia. Two different mechanisms for dust-iron mobilization into a bioavailable form are considered in this study. A global 3-D chemical transport model (GEOS-Chem), implemented with an iron dissolution scheme, is employed to estimate the atmospheric fluxes of soluble iron, while a dust/biota assessment tool (Boyd et al., 2010) is applied to evaluate the amount of bioavailable iron formed through the slow and sustained leaching of dust in the ocean mixed layer. The effect of iron-laden mineral dust supply on surface ocean biomass is investigated by comparing predicted surface chlorophyll-a concentration ([Chl-a]) to remotely-sensed [Chl-a] data obtained from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS). As the dust transport episodes examined here represent large summertime outflows of mineral dust from South American continental sources, this study suggests that (1) atmospheric fluxes of mineral dust from Patagonia are not likely to be the major source of bioavailable iron to ocean regions characterized by high primary productivity; (2) even if Patagonian dust plumes may not cause visible algae blooms, they could still influence background [Chl-a] in the South Atlantic sector of the Southern Ocean.</p>

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8. Steven Lohrenz University of Southern Mississippi	Assessing Impacts of Climate and Land Use Change on Terrestrial-Ocean Fluxes of Carbon and Nutrients and Their Cycling in Coastal Ecosystems	Talk	<p>Changing climate and land use practices have the potential to dramatically alter coupled hydrologic-biogeochemical processes and associated movement of water, carbon and nutrients through various terrestrial reservoirs. Such changes will ultimately influence the delivery of dissolved and particulate materials from terrestrial systems into rivers, estuaries, and coastal ocean waters. Consequences of climate- and land use-related changes will be particularly evident in large river basins and their associated coastal outflow regions. The large spatial extent of such systems necessitates a combination of satellite observations and model-based approaches coupled with targeted ground-based site studies to adequately characterize relationships among climate forcing (e.g., wind, precipitation, temperature, solar radiation, humidity, extreme weather), land use practice/land cover change, and transport of materials through watersheds and, ultimately, to coastal regions. Here, we describe a new NASA-funded Interdisciplinary Science project that will utilize an integrated suite of models in conjunction with remotely sensed as well as targeted in situ observations with the objectives of describing processes controlling fluxes on land, their coupling to riverine systems, and the delivery of materials to estuaries and the coastal ocean. Terrestrial hydrological ecosystem models coupled with hydrological-biogeochemical models of coastal and estuarine systems will be used in conjunction with satellite and in situ observations to examine water quality, transport, and ecosystem function resulting from climate and land use change. The proposed effort will address the goals of integrating hydrological and ecological models to better describe and understand the connectivity of upland and coastal marine systems and the manner in which climate, weather and human activities influence processes within the connecting watershed. The chosen region of study will be the Mississippi River and its watershed, which provides an excellent setting to carry out this work as there are a large number of supporting datasets and on-going programs that will complement this work. The proposed work is also closely aligned with objectives of the North American Carbon Program and the Ocean Carbon Biogeochemistry (OCB) program and will contribute to efforts to refine continental and ocean margin carbon budgets. Results will also benefit efforts to describe and predict how land use and land cover changes impact coastal water quality including possible effects of coastal eutrophication and hypoxia. Finally, the modeling and observational approaches developed for this work will have applicability to other large river watershed-coastal systems.</p>



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9.	Mr. Suresh Kumar Santhana Vannan ORNL	Data and Metadata Web Services at ORNL DAAC: OGC, SOAP, OPeNDAP, and OAI-PMH Services	Poster	<p>ORNL DAAC provides access to data and metadata using various Web service protocols. Several ORNL DAAC and other relevant data sets are provided using Open Geospatial Consortium (OGC) Web Map Service (WMS) and Web Coverage Service (WCS). The OGC services provide an interoperable web based service to visualize and download geospatial data. MODIS land product subsets are delivered using Simple Object Access Protocol (SOAP) Web service. The MODIS SOAP Web service provides users the capability to programmatically extract MODIS land product subsets up to 201 sq. km. ORNL DAAC metadata are delivered to other metadata catalogues such as GCMD using OAI-PMH. OAI-PMH provides a standard mechanism to register metadata record with other data discovery systems. ORNL DAAC also uses Data Access Protocol (DAP) for distribution of selected ORNL data sets. DAP can be accessed from Web browsers, Open Source, and commercial software clients. Data served through OGC and DAP Web service can also be accessed from mercury metadata search tool.</p> <p>Proxy Ocean Color Data Generator for VIIRS            Ronald Vaughan<sup>1</sup>, Robert Arnone<sup>2</sup>, Zhongping Lee<sup>3</sup>, Joe Zajic<sup>4</sup>  <sup>1</sup> Qinetiq North America, Stennis Space Center, MS 39529  <sup>2</sup> Naval Research Laboratory, Stennis Space Center, MS 39529  <sup>3</sup> Geosystems Research Institute, Mississippi State University, Stennis Space Center, MS 39529  <sup>4</sup> NOAA, Silver Spring, MD</p> <p>Abstract            Proxy ocean color data for the Visible/Infrared Imaging Radiometer Suite (VIIRS) is being generated in near real time from MODIS Aqua satellite. VIIRS will be flown on the NPP and JPSS (Joint Polar Satellite System) and will provide ocean color data at 750m spatial resolution for 6 channels ( 412nm, 445nm, 488nm, 555nm, 672nm, 746nm) along with NIR data at 865nm. The Ocean Proxy Generator (OPG) is based on: a) developing hyperspectral water leaving radiance derived from level 2 of the MODIS processing b) propagating the radiance to the top of the atmosphere and c) convolving the top of atmosphere radiance with the VIIRS spectral response. The processing is performed per pixel to construct a VIIRS proxy image. Proxy imagery is used to evaluate and characterize the sensor pre-launch, as well as exercise the end to end processing of the data and generation of ocean color products. The processing is provided by the Government Resource for Algorithm Verification Independent Test and Evaluation (GRAVITE) system at NOAA and the Automated Processing System (APS) ocean color software developed at NRL SSC). The VIIRS proxy data has been integrated into "standard" ocean color level 2 processing using l2gen to create VIIRS ocean color products. This data can be generated on a global scale, therefore providing various type water scenes (coastal, deep water, etc.) to evaluate the capability for VIIRS for ocean color products. This poster/presentation will outline the steps and methods used to derive proxy VIIRS top of atmosphere ocean image data for use in the evaluation of the VIIRS sensor and the processing software.</p>
10.	Mr. Ronald D Vaughan Jr. Qinetiq North America / NRL	Proxy Ocean Color Generator for VIIRS	Poster	<p>Proxy ocean color data for the Visible/Infrared Imaging Radiometer Suite (VIIRS) is being generated in near real time from MODIS Aqua satellite. VIIRS will be flown on the NPP and JPSS (Joint Polar Satellite System) and will provide ocean color data at 750m spatial resolution for 6 channels ( 412nm, 445nm, 488nm, 555nm, 672nm, 746nm) along with NIR data at 865nm. The Ocean Proxy Generator (OPG) is based on: a) developing hyperspectral water leaving radiance derived from level 2 of the MODIS processing b) propagating the radiance to the top of the atmosphere and c) convolving the top of atmosphere radiance with the VIIRS spectral response. The processing is performed per pixel to construct a VIIRS proxy image. Proxy imagery is used to evaluate and characterize the sensor pre-launch, as well as exercise the end to end processing of the data and generation of ocean color products. The processing is provided by the Government Resource for Algorithm Verification Independent Test and Evaluation (GRAVITE) system at NOAA and the Automated Processing System (APS) ocean color software developed at NRL SSC). The VIIRS proxy data has been integrated into "standard" ocean color level 2 processing using l2gen to create VIIRS ocean color products. This data can be generated on a global scale, therefore providing various type water scenes (coastal, deep water, etc.) to evaluate the capability for VIIRS for ocean color products. This poster/presentation will outline the steps and methods used to derive proxy VIIRS top of atmosphere ocean image data for use in the evaluation of the VIIRS sensor and the processing software.</p>

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11.	Dr. Mark A Vincent <i>Raytheon</i>	Spatial and Temporal Considerations for Atmospheric and Terrestrial Observations	Poster	Different modeling algorithms require observations at vastly different spatial and temporal scales. Comparisons will include the global carbon/climate cycles using OCO data and the solid earth, ecosystem structure and ice dynamics models using DESDynI data. Emphasis will be on choosing satellite orbits for repeat patterns and swath widths but the availability of ground observations for both verification and model enhancement will also be addressed.
12.	Prof. Jinchun Yuan <i>Elizabeth City State University</i>	Multiple linear and non-linear regressions of CO2 parameters to temperature and salinity in surface oceans	Poster	Systematical monitoring of carbon dioxide (CO2) in surface seawater is essential for evaluating air-sea carbon fluxes and the fate of anthropogenic carbon. Although recently reported linear and non-linear regressions of pCO2 on temperature and salinity can be used to estimate pCO2 distribution from satellite data, the quality of estimated pCO2 is modest as the correlation coefficients of the regression equations are relatively small. Furthermore, as these regressions were derived from coastal waters, their broad applicability is questionable. Here, we report some regressions of alkalinity and dissolved inorganic carbon (DIC) on temperature and salinity. By using alkalinity or DIC as the dependent variable instead of pCO2, a much higher correlation coefficient was observed. Additionally, since a global dataset was used to conduct regression, these equations should be applicable to surface waters of the ocean. Furthermore, since they are related to alkalinity and DIC through chemical equilibrium, pCO2 and pH can also be estimated from satellite data using these equations. Finally, as temperature and salinity can be determined from orbital sensors, these regressions can be used to estimate the distribution of CO2 parameters in surface waters from remote sensing data.